LOW TEMPERATURE ELECTROLYTE AD-119 - SUMMARY OF 1982 WORK

Lithium fluoride additions are known to decrease the liquidus temperature of Hall Cell electrolyte and increase the conductivity. Liquidus temperature and conductivity are both complex functions of the electrolyte composition and become even more complex with LiF additions. Literature data are usually reported for a narrow range of electrolyte composition and it does not correspond to Sebree or Columbia Falls existing electrolyte compositions or envisioned modifications.

Statistically design experiments were conducted (using as a base the Sebree electrolyte composition) to develop a quantitative relationship with liquidus temperature and electrical conductivity as the dependent variable and LiF concentration (1, 3, 5 wt %) and bath ratio (1.0, 1.25 and 1.5) as the independent variable. Al_2O_3 and CaF_2 concentrations were fixed at 3.5 wt % and 4.0 wt %, respectively. Data analysis of the experiments conducted in the last month of 1982 is still being performed.

Preliminary analysis of the results indicate that:

(1) The decrease of Hall Cell electrolyte liquidus temperature as a result of LiF addition, for the three bath ratios investigated, correspond to about 4.5°C for every one percent increase in LiF addition. This results in almost half the calculated results from literature data reported for higher bath ratios. For a bath ratio of 1.25 the

liquidus temperature decreased from 946°C to 926°C for an increase in LiF from 1 wt % to 5 wt % whereas the literature prediction is 959 to 918°C. Substantial discrepancy in experimental results and calculated value is observed for the low bath ratio of 1.0. The liquidus temperature decreases, for increasing LiF addition from 1 wt % to 5 wt %, from 925°C to 911°C compared to calculated values of 910°C to 869°C, respectively. This again indicates that literature data predictions are limited to high bath ratios. It also indicates that the incremental benefit of using lithium fluoride addition decreases with decreasing bath ratio if only liquidus temperature is the major factor.

(2) Conductivity data obtained in this study is less reliable than liquidus temperature data, however, in general measured values were higher than calculated from literature data. In general terms maximum electrolyte conductivity is obtained at high bath ratio and high LiF addition. Accordingly, there is no particular advantage to modify a Hall Cell electrolyte to low bath ratio (i.e. toward CR=1.0) and high LiF addition based only on conductivity data and on the above liquidus temperature data. At 1 wt % LiF the conductivity measured was 2.09, 2.61 and 3.05 Ω^{-1} cm^{-1} for bath ratios of 1, 1.25 and 1.5, respectively, compared to predicted values of 2.15, 2.40 and 2.68 Ω^{-1} cm^{-1}, respectively.

A mathematical model relative to the low bath ratios fitting the experimental liquidus temperature and conductivity is being done. This model will be utilized to formulate recommendations.